SPECIFICATION

TITLE OF THE INVENTION

A METHOD FOR CODING POSITIONS OF DATA ELEMENTS IN A DATA
STRUCTURE

BACKGROUND OF THE INVENTION

[0001] Data structures frequently contain data elements which are to be
differentiated by their positions with respect to each other. Position coding
methods make this possible by allocating position codes to all data elements in a
predetermined sequence.

[0002] A position coding method is described in [1] which is employed in a
method for binary coding of XML data. This method uses XML schema
definitions (in the context of a standardized MPEG-7 method, for example) in order
to generate the codes for the individual data elements of the XML description. In
this respect, individual elements or element groups of the same type as defined by
the XML schema definition can occur several times in the document. In this case, a
position code (PC) is transmitted. The position code includes the binary
representation of a whole number which specifies the position with regard to the
adjacent elements. The position code is associated with the element on the basis of
the position with respect to the adjacent elements in the document to be coded.
This has the advantage that the position code of an element is preserved irrespective
of the sequence in which adjacent elements are transmitted. Elements, therefore,
can be lost in transmission without this affecting the position codes or the position
of the elements which are subsequently decoded via a decoder.

[0003] A disadvantage of this known method is that the XML document
must be known at the time of coding since no new positions can be inserted with
the previously existing position coding; instead, new positions can just be
appended. This is a disadvantage especially when an XML document is already to
be coded or transmitted while it is being created; for example, in live transmissions
according to a transmission standard, such as MPEG-4 or MPEG-7.

[0004] For the purposes of solving this problem, gaps can be left between
the position codes used, which can be filled when needed. Particularly in the case

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of live coding, however, the need-based readiness of such gaps which must be defined in advance is difficult to predict. Additionally, the overall quantity of possible gaps is limited by the XML schema definition in many cases. Then, if no more position codes kept free by such gaps are available at the position to be inserted, all the adjacent elements already sent have to be transmitted again with newly generated position codes. This frequently occurs in the case of a number of data elements of the same type; for example, in the case of identical elements or element groups occurring several times in a document. The consequence is a marked deterioration in coding efficiency and also a markedly increased processing overhead both at the coder and at the decoder.

[0005] The present invention is therefore directed toward a method and a device for coding positions of data elements in a data structure in which the positions of newly added data elements can be coded in a simple and efficient manner.

SUMMARY OF THE INVENTION

[0006] The method according to the present invention has the advantage that the position coding is robust with respect to data loss since position codes are retained. At the same time, where the method is used for coding XML documents, dynamic documents which are generated during the coding process can be coded efficiently. This is made possible by the fact that new positions can be coded between existing positions without elements and their position codes having to be transmitted again.

[0007] Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

BRIEF DESCRIPTION OF THE FIGURES

[0008] Fig. 1 is a representation of a position code for a data element, where the position code has been generated with the aid of the method according to the present invention.

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[0009] Fig. 2 shows a data structure where position codes are associated with the data elements, which position codes have been generated with the aid of the method according to the present invention.

[0010] Fig. 3 shows the data structure of Fig. 2, where two new data elements have been added.

DETAILED DESCRIPTION OF THE INVENTION

[0011] In the embodiment of the present invention considered in the following, position codes are associated with the data elements of the data structure in ascending order of the data element positions, which position codes also include rational numbers in a predetermined value range arranged in ascending order. Then, if a position between two existing positions is to be addressed, this is always possible since an infinitesimal quantity of rational numbers always exists between two given rational numbers R1 and R2 where R1 ≠ R2. In real implementations, this quantity is admittedly not infinitesimal, but always may be selected sufficiently large; for example, >1024. If the position code of the first data element is not equal to zero, data elements whose position code is smaller than the position code of the first data element also may be inserted.

[0012] The use of rational numbers has the further advantage that it enables the shortest possible binary representation.

[0013] Fig. 1 shows a position code for a data element. This position code includes the binary representation of a rational number to the base 2 in the value range [0,1]. The binary representation of the rational number includes N=15 bits, where N*=12 data bits are present (MSB bit, bit 1 to bit 11; N*<=N), being arranged in three quadruples. The significance of the data bits is stated under the bits in each case. The data bits are preceded by three extension bits, where the quantity of extension bits specifies the quantity of data bit quadruples present. The first two extension bits are set to one and the last extension bit is set to zero. Setting the last extension bit to zero indicates that the following bits constitute data bits. With the aid of the representation selected in Fig. 1, therefore, a rational number is represented by N bits, of which N* bits include data bits, where N*<=N and N*=4k (in this respect, k includes a whole number in the value range [1, α]).

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[0014] Fig. 2 shows a data structure in the form of a data tree, where the position codes of the data elements have been generated with the aid of the inventive method described above. The data structure includes a data element A which is linked to five data elements B. Position codes P are associated with the data elements B in ascending order in the form of rational numbers 1/8, 1/4, 3/8, 1/2 and 5/8. Furthermore, the binary representations of the position codes are specified as shown in the diagram in Fig. 1.

[0015] Fig. 3 shows a data structure in accordance with Fig. 2, where two more new data elements have been inserted between the data element with the position code 3/8 and the data element with the position code 1/2. These newly added data elements are shown in gray in Fig. 3. As a result of the use of rational numbers for the position codes, two values now may be found for the position codes of the new data elements which lie between the values 3/8 and 1/2. The numbers 7/16 and 15/32 have been selected for these values in Fig. 3. It is therefore possible to generate new position codes for new data elements in the data structure without the existing position codes having to be changed. Associated position codes, therefore may be retained and any desired number of new data elements inserted at any desired position.

[0016] Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the present invention as set forth in the hereafter appended claims.

[0017] References

[0018] [1] ISO/IEC 15938-1 Multimedia Content Description Interface – Part 1: Systems, Geneva 2002